



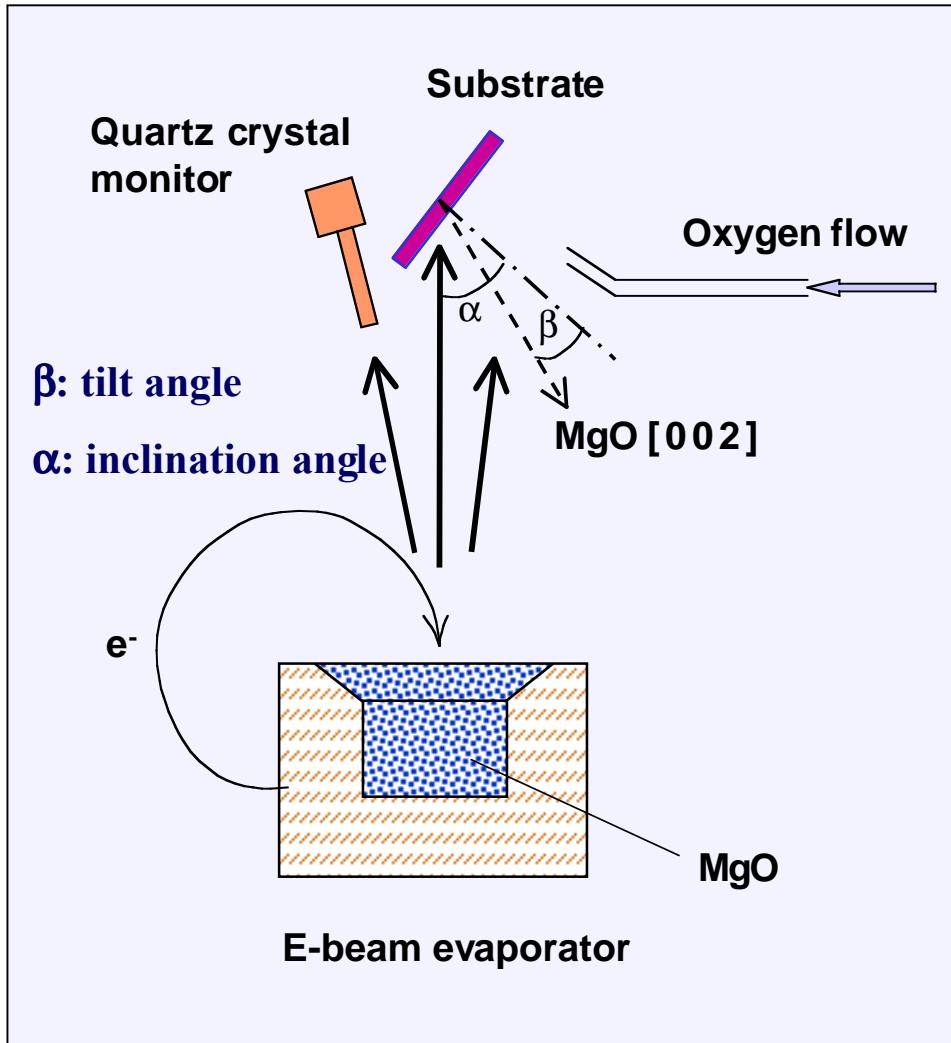
ISSUES RELATED TO FABRICATION OF YBCO-COATED CONDUCTORS BY INCLINED SUBSTRATE DEPOSITION*

Beihai Ma, U. Balachandran, M. Li, B.L. Fisher,
R.E. Koritala, D.J. Miller, and S.E. Dorris

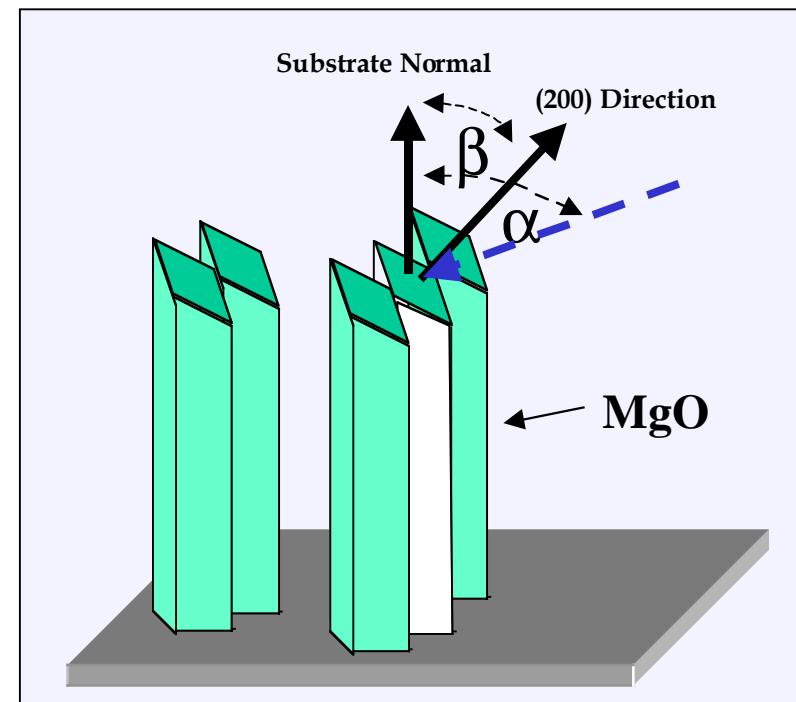
Argonne National Laboratory, Argonne, IL 60439

*Work supported by the U.S. Department of Energy, Energy Efficiency and Renewable Energy.

Inclined Substrate Deposition (ISD)



- Simple, fast process.
- Room temperature.
- Substrate independent.
- Amenable to scale-up.
- Demonstrated to grow highly textured MgO.



ISD at ANL - present status



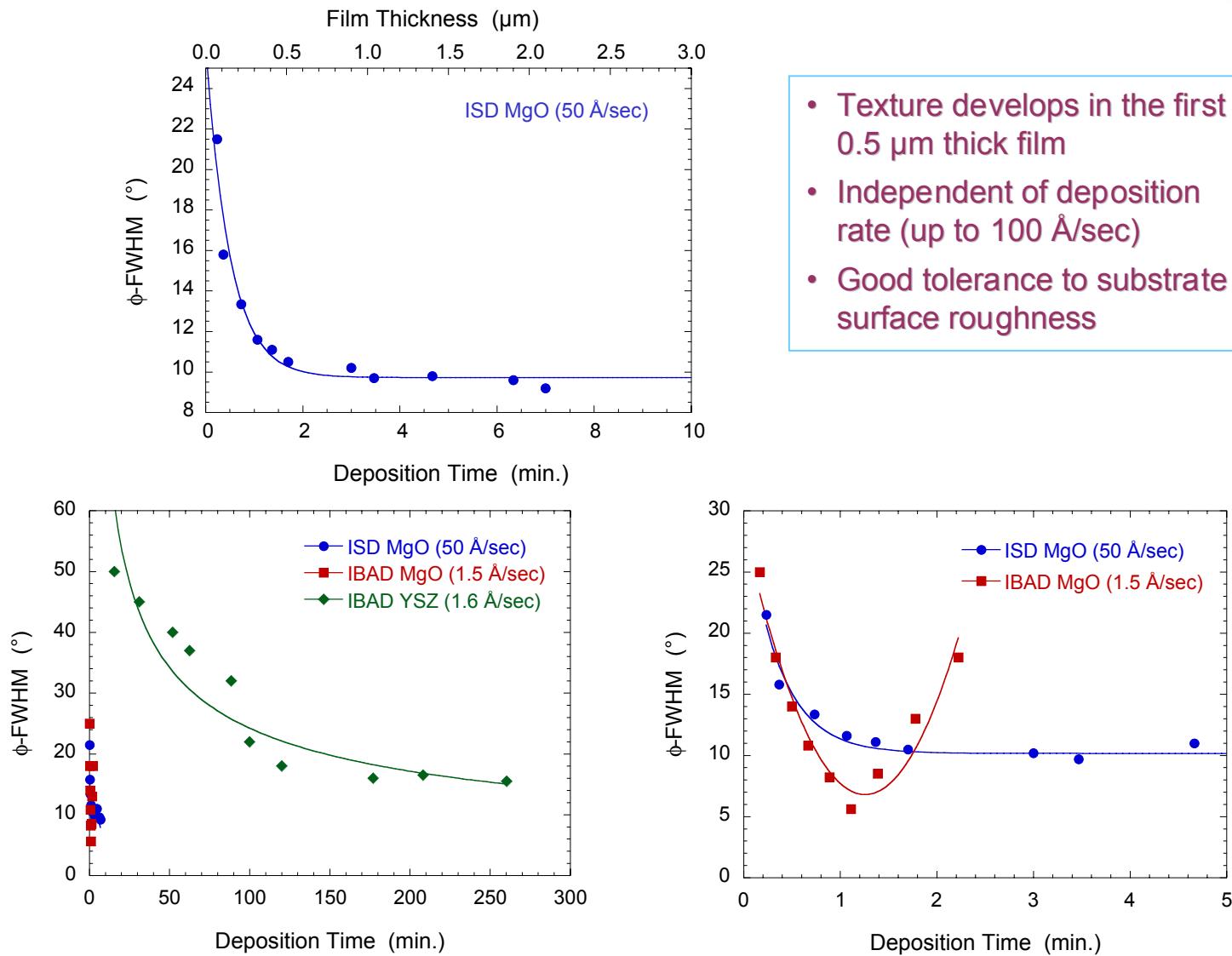
Proven attributes of ISD:

- good texture at high speed (20-100 Å/sec; FWHM $\approx 10^\circ$)
- substrate-independent texture (roughness 2-30 nm)
- demonstrated scale-up potential (couple of 35-cm pieces;
FWHM = 12-18 $^\circ$)
- benefits of homoepitaxial cap layer (roughness decreased
from 20 nm to 8 nm)

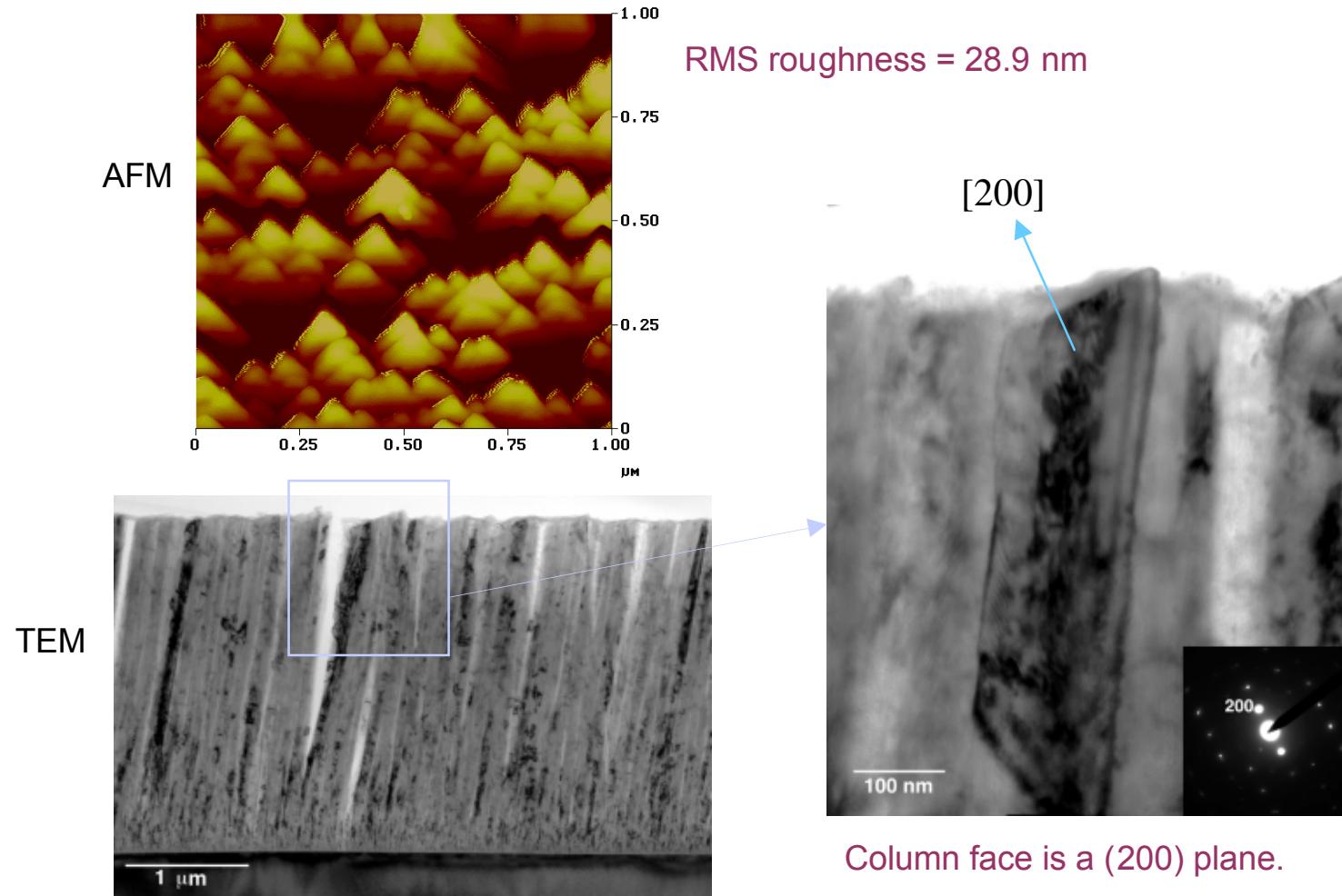
Critical issues:

- obtaining stronger texture, very high J_c in HTS
- Addressing effect of roughness
- improving texture in continuous processing
- improvement/scale-up of buffers, HTS
(\approx generic issues common to all)

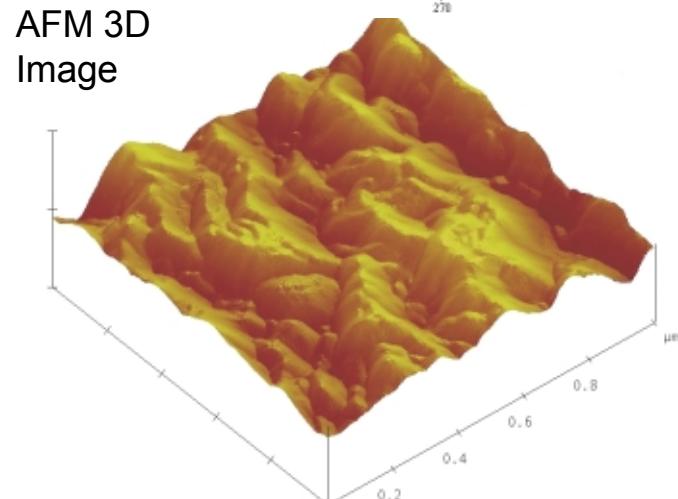
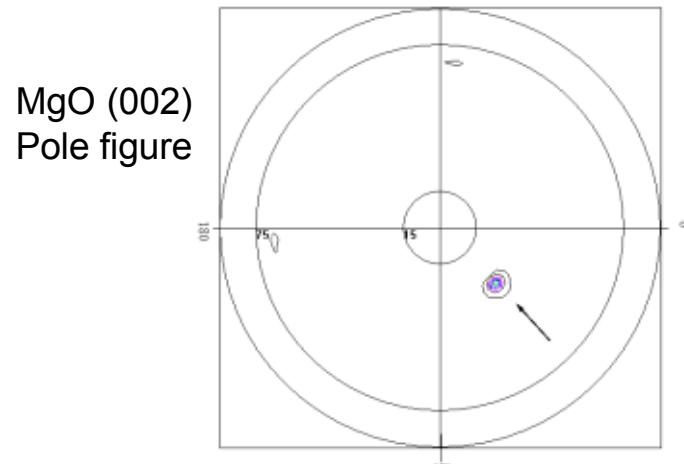
Deposition of Biaxially Textured Films



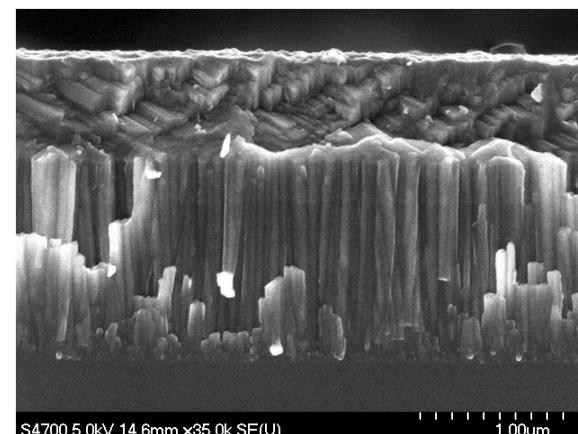
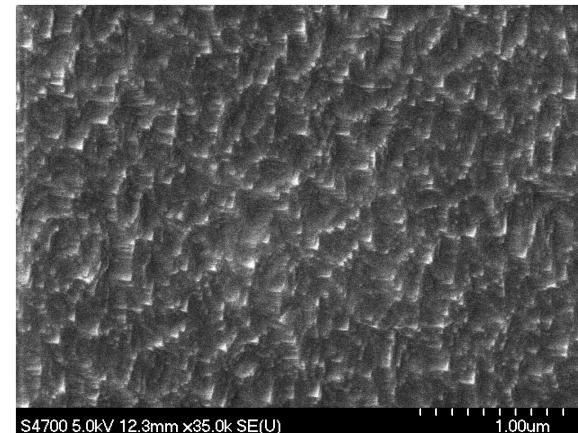
MgO Template Film Grown by ISD



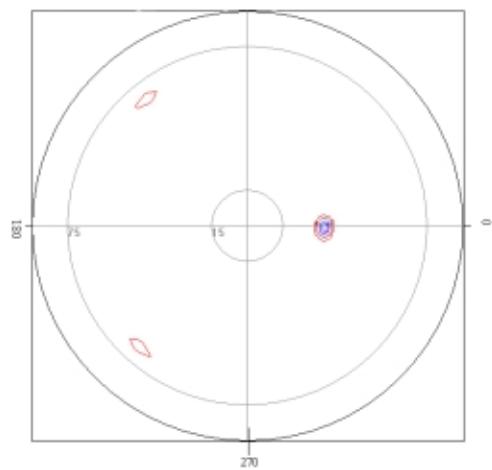
ISD MgO with Homo-epi MgO Layer



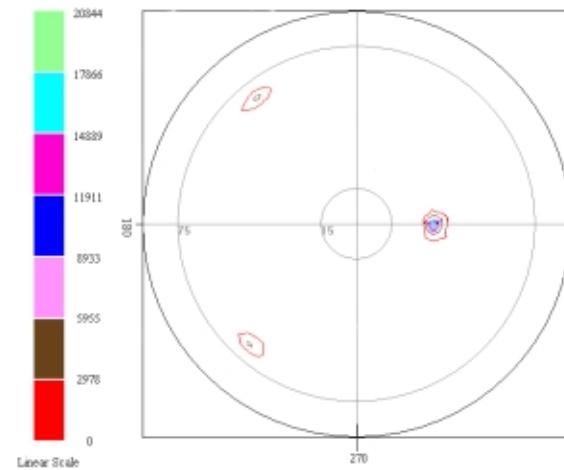
RMS roughness = 8.3 nm



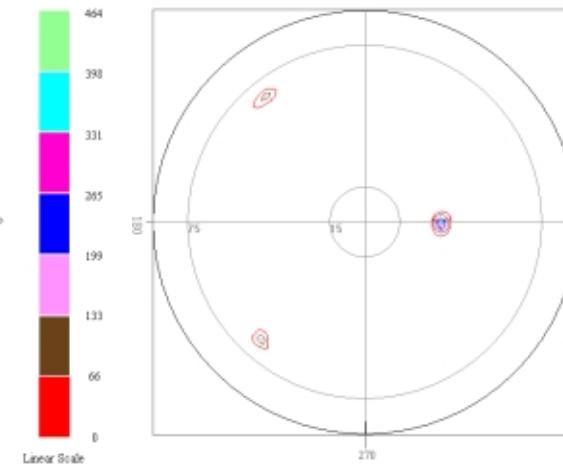
CeO₂/YSZ Buffer Layers on ISD MgO



MgO (002)



YSZ (002)



CeO₂ (002)

“Cube-on-cube” epitaxy relationship:

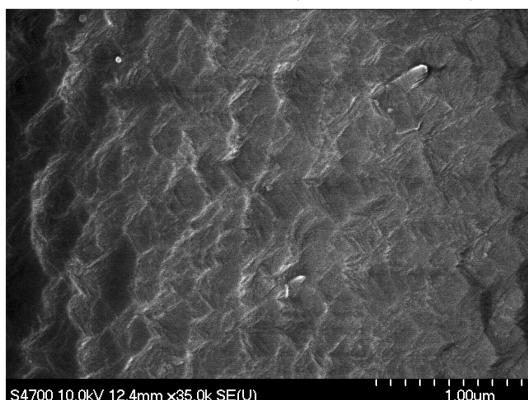
CeO₂[001] // YSZ[001] // MgO[001] and
CeO₂[110] // YSZ[110] // MgO[110]

Near-term Issues: Buffer layer roughness & uniformity

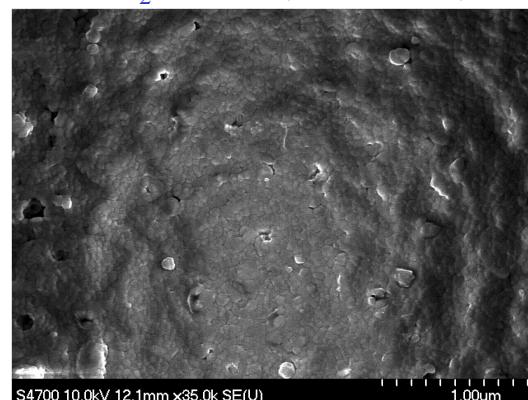


- Optimize deposition conditions for buffer layers.

YSZ surface (S.R. \approx 8 nm)

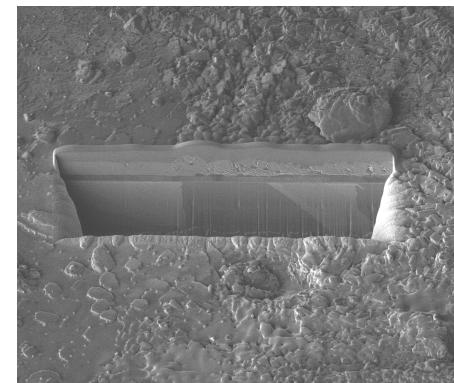


CeO₂ surface (S.R. \approx 8 nm)

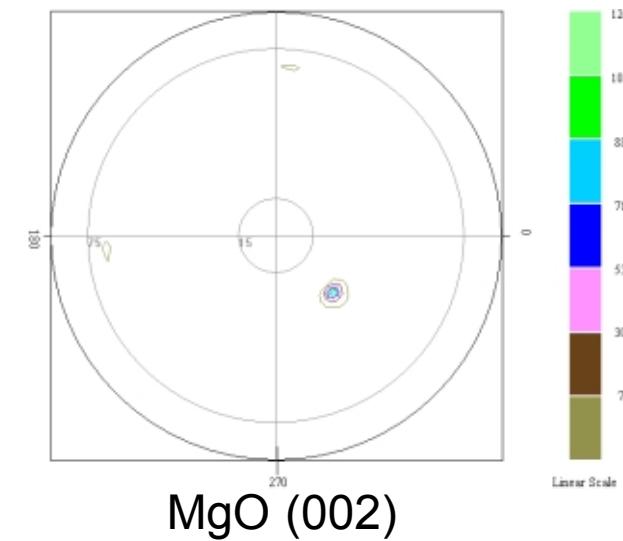
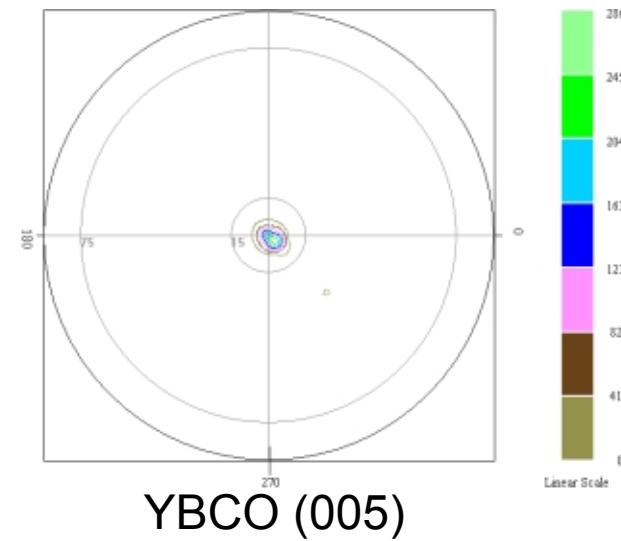
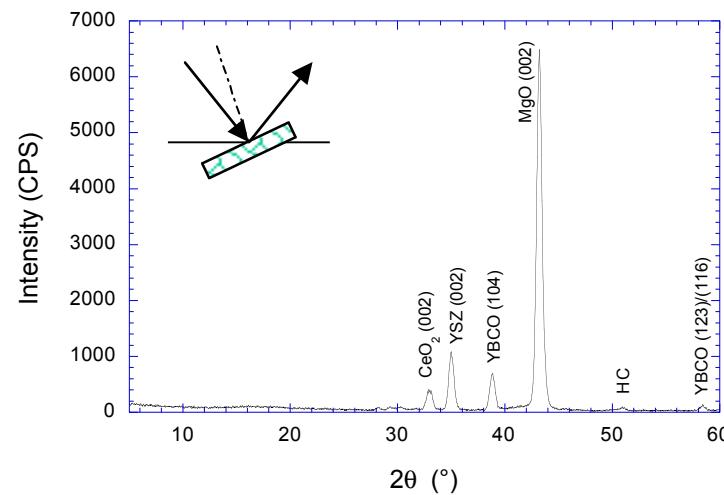
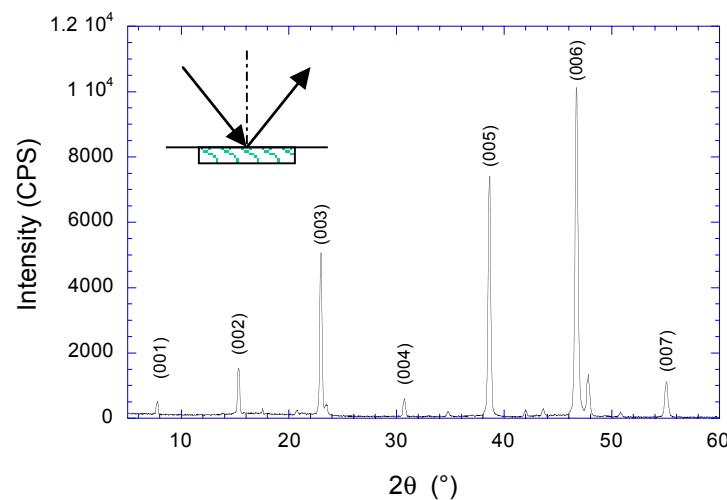


- Optimize buffer layer architecture and improve thickness uniformity.

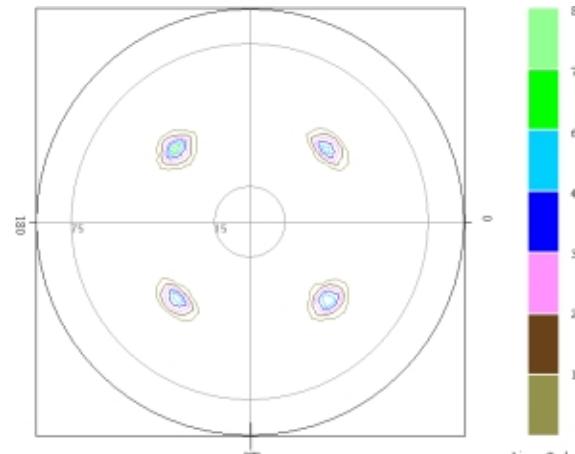
Thickness (nm)	Measured	Expected
CeO ₂	\sim 100	15
YSZ	\sim 40	200
MgO	\sim 500	500



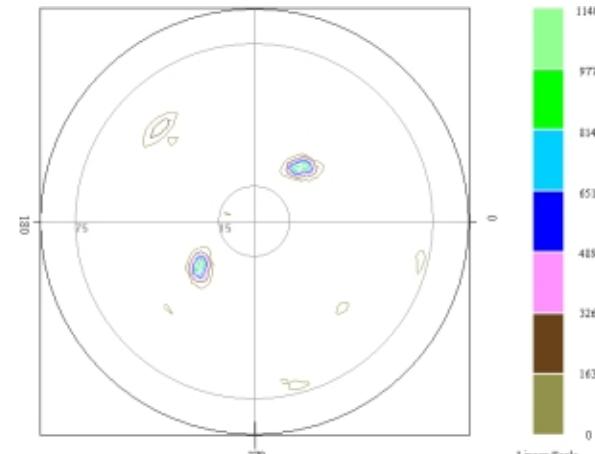
YBCO Grown on CeO_2/YSZ -Buffered ISD MgO Substrate



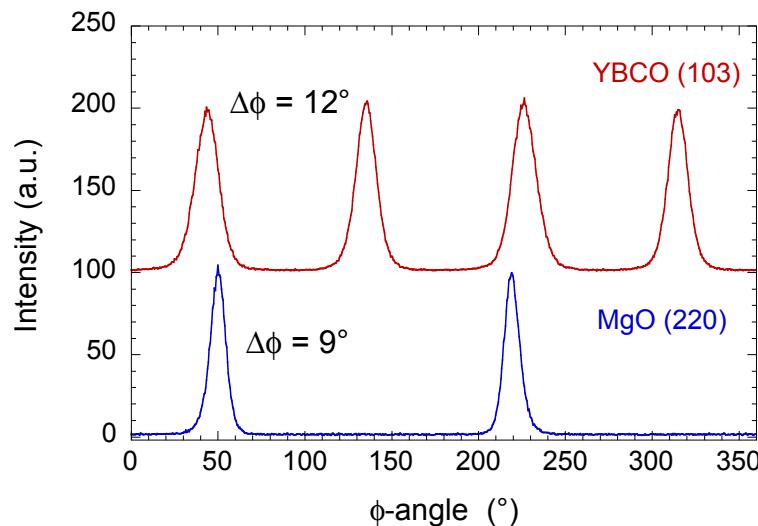
YBCO Grown on CeO_2/YSZ -Buffered ISD MgO Substrate



YBCO (103)

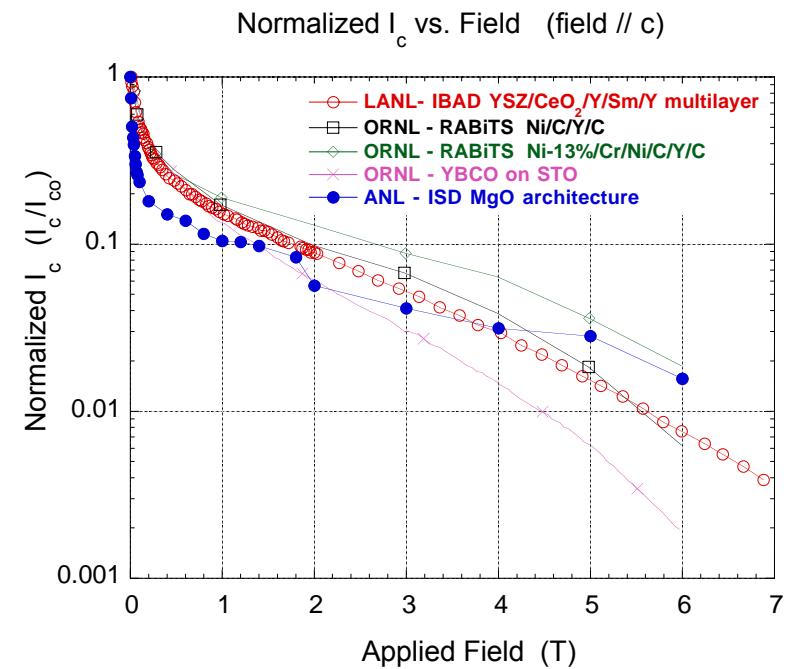
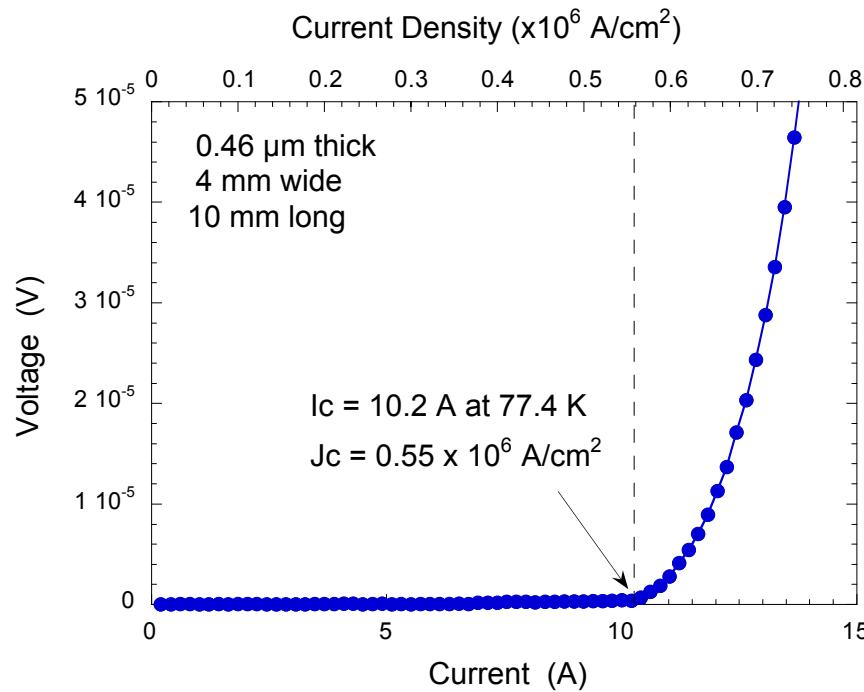


MgO (220)



Orientation relationship:
YBCO[001] // MgO[112] and
YBCO[100] // MgO[111] or
YBCO[010] // MgO[110]

Properties of YBCO on Buffered ISD MgO



Ref: LANL and ORNL data are from 2001 Peer Review reports.



Issues for Future Work

Optimize Buffer Layer Deposition Conditions:

- Reduce surface roughness
- Reduce defects/particles
- Address film thickness issues

YBCO Films on ISD MgO:

- Enhance texture
- Obtain higher J_c
- Fabricate thicker films

Scale Up:

- Improve texture in continuous processing
- Optimize fabrication conditions